10th Annual Users Group Conference

Hilton Albuquerque, NM

June 5–9, 2000

Department of Defense

High Performance Computing Modernization Program

— The State of the Program —

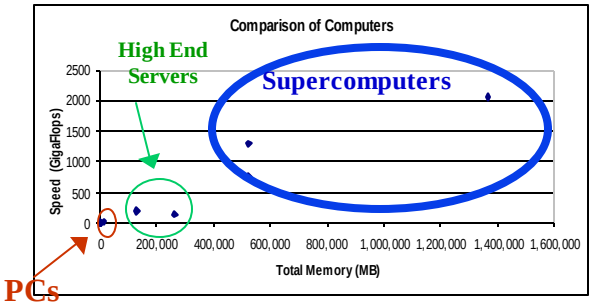
Presented by

Mr. Cray Henry

Director

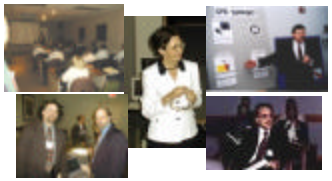
HPC Modernization Program

- Mission
- High Performance Computing OIPT
- Program Requirements
  - Trends
  - Acquisition Impact
  - Allocations
- Future HPC Agenda

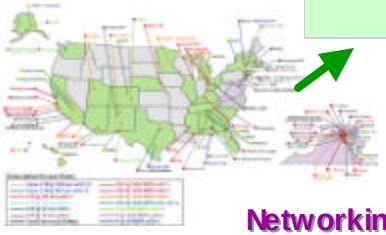


Super Computers

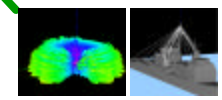
HPCMP

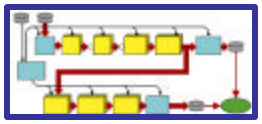


Domain Expertise



Networking





Software Development

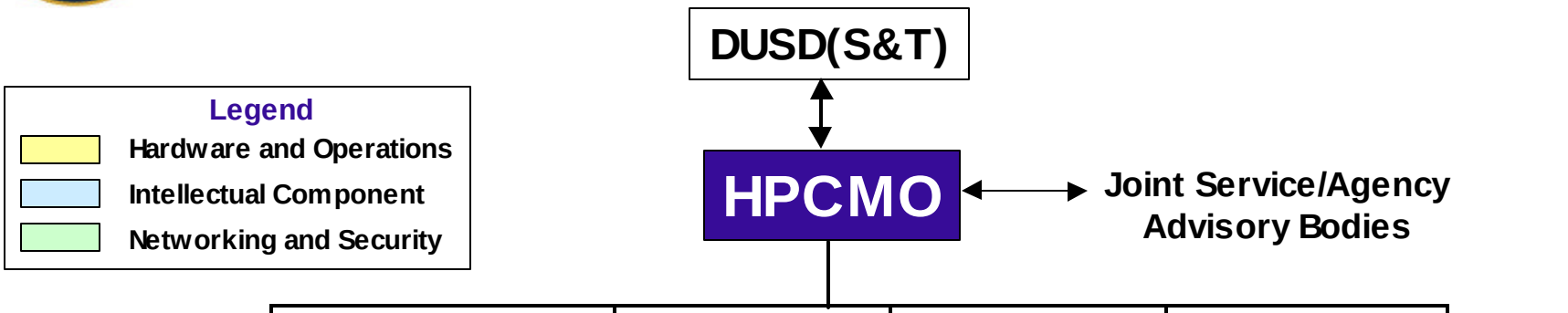
Today's DoD HPC Modernization Program provides world class services to DoD

Program Mission

To deliver world class high performance computational capability to the DoD's Science & Technology (S&T) and Test and Evaluation (T&E) Communities enabling them to incorporate technological advantage into superior weapons, warfighting capabilities, and related support systems more rapidly and affordably.

The value to DoD is the results of the work DoD scientists and engineers are able to accomplish with HPC — The return is ENORMOUS!

HPCMP Organizational Components
—Truly a Joint Effort

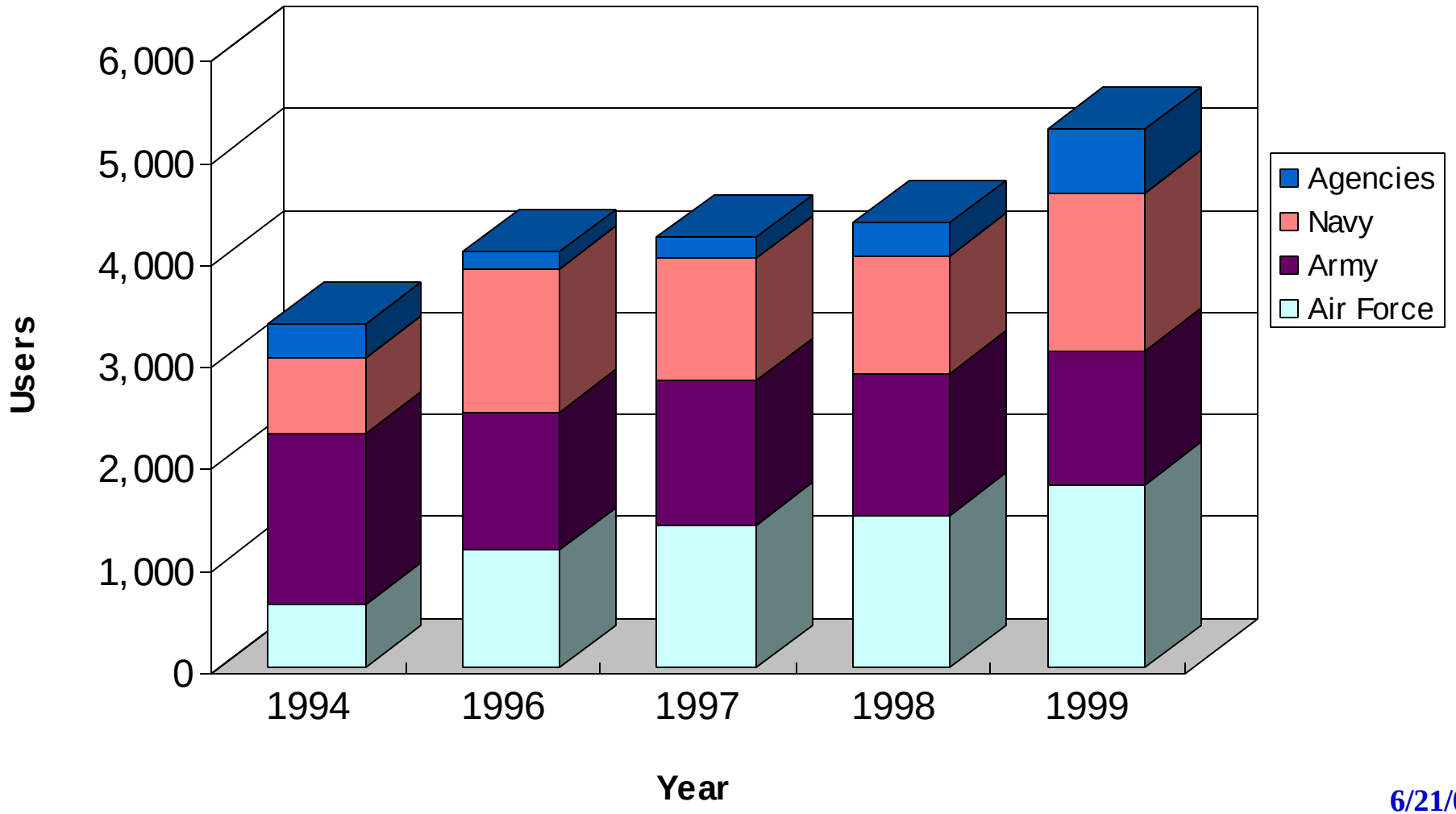


Army	ARL ERDC	AHPCRC SMDC WSMR RTTC TARDEC	11 CHSSI Projects 4 CTA Leaders	26 Sites	8 Projects
Navy	NAVO	NAWCAD NRL NAWCWD SSCSD	12 CHSSI Projects 3 CTA Leaders	20 Sites	12 Projects
Air Force	ASC	AAC AFFTC AFRL/SN AEDC AFRL/IF MHPCC	12 CHSSI Projects 3 CTA Leaders	15 Sites	11 Projects
Defense Agencies		JNTF		8 Sites	3 Projects
Academia	PET Partners	ARSC	CHSSI/Users	5 Gateways	12 Leaders

	AIR FORCE	ARMY	NAVY	DEFENSE AGENCIES
Users	1,762*	1,311*	1,548*	628*

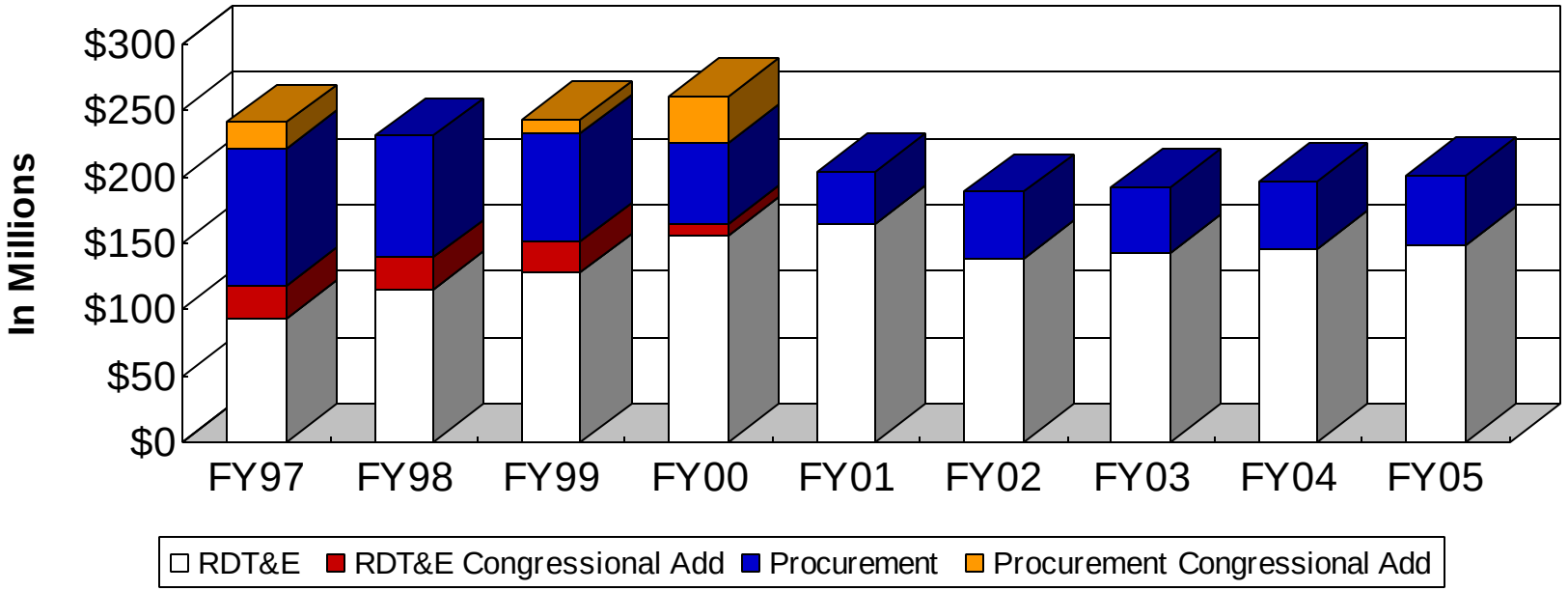
* Source: 1999 Requirements Report

HPC Modernization Program
User Base



DoD HPCMP

Funding Levels (As of FY 01 PB - February 2000)

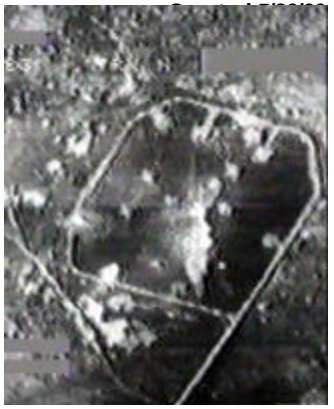


	FY97	FY98	FY99	FY00	FY01	FY02	FY03	FY04	FY05
Procurement (Capital Investments)	122.7	87.1	91.4	95.8	40.0	50.4	49.4	50.3	51.9
RDT&E - Networking (includes Security)	16.0	21.7	17.0	29.3	32.7	32.9	33.1	33.7	34.6
RDT&E - CHSSI	21.1	20.9	23.6	21.6	22.3	20.7	20.7	21.8	22.3
RDT&E - SRCs (includes PET)	81.3	96.4	111.0	113.4	109.0	84.4	89.2	90.3	91.7
HPCMO Total	**241.1**	**226.1**	**243.0**	**260.1**	**204.0**	**188.4**	**192.4**	**196.1**	**200.5**

High Performance Computing Overarching Integrated Product Team (HPC-OIPT)

HPC OIPT Background

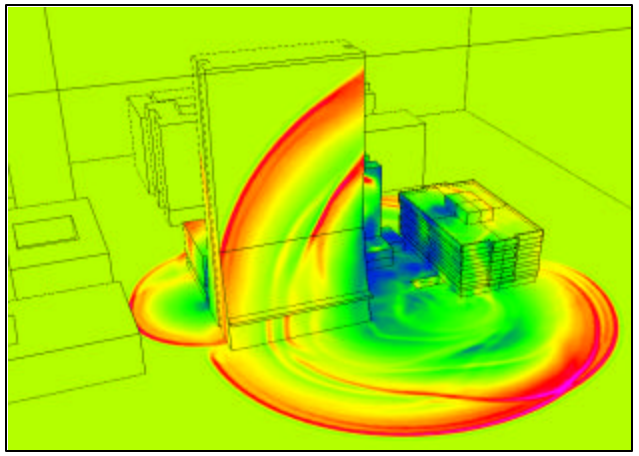
An HPC Contribution to Desert Storm:
GBU-28 Laser Guided Munitions



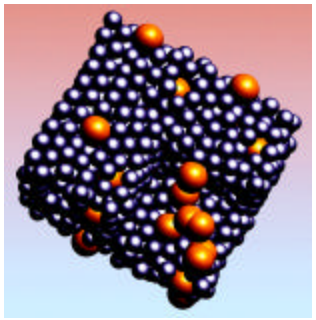
- **Congress directs DoD to improve supercomputing capabilities in 1992**
- **DoD initiates HPCMP in 1994 to support DoD S&T**
- **DoD T&E HPC Modernization Plan submitted to Congress in May 1998**
  - **Identified Annual funding Requirement: $50M to $150M**
- **USD(AT&L) tasked DUSD(S&T) to lead an OIPT to consider:**
  - **How to leverage existing HPCMP to meet the needs of S&T, DT&E and OT&E communities?**
  - **What management structure best meets the collective needs of the these communities?**
  - **What resources are required?**

Findings of the OIPT

- HPC is a critical enabling tool for DoD
  - Decreased time-to-solution
  - Increased ability to solve complex problems
  - Enables new and innovative approaches
- S&T and T&E requirements should be integrated
  - Enables leveraging of resources
  - Facilitates transition of S&T technologies into T&E
- Additional resources required
  - To restore out-year funding
  - Balance S&T and T&E Program
  - Partially fund Congressional sites
- Right overall management structure is in place

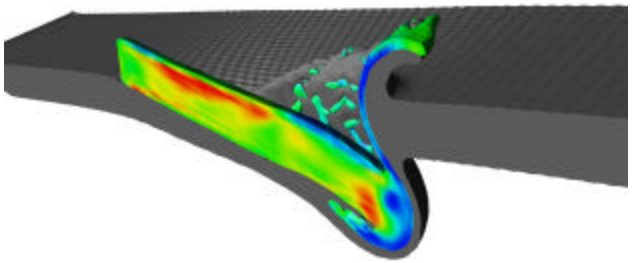


Impact



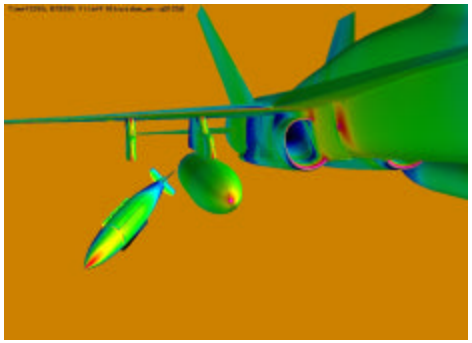
Basic Research

Simulating High-Energy Density Rocket Fuels



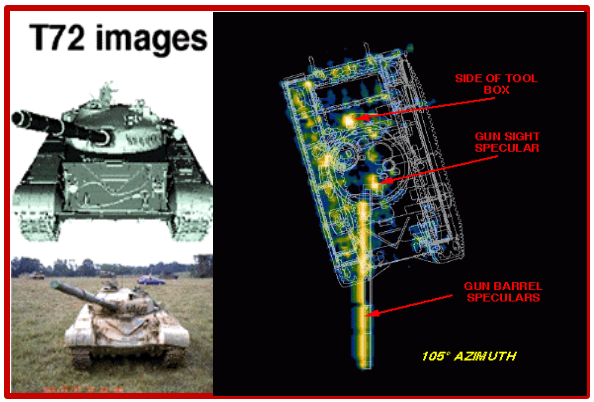
Advanced Technology

Armor and Projectile Design



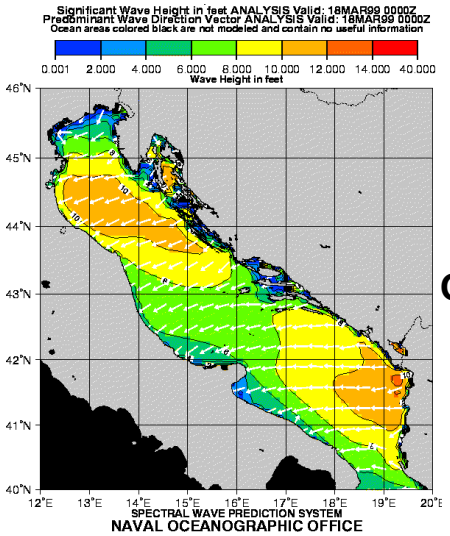
Developmental T&E

Support of Aircraft-Store Compatibility and Weapons Integration



Intelligence

Radar Cross-Sections Predictions



Operations

Ocean/wave forecasting

OIPT Recommendations

- Organization:
  - Focus on S&T and T&E
  - Leverage existing program to support both communities
- Establish a Stable Investment Profile
  - Allow continuing access to world class supercomputing capability
  - Target funding levels
    - $19M/year Procurement
    - $19M/year RDT&E

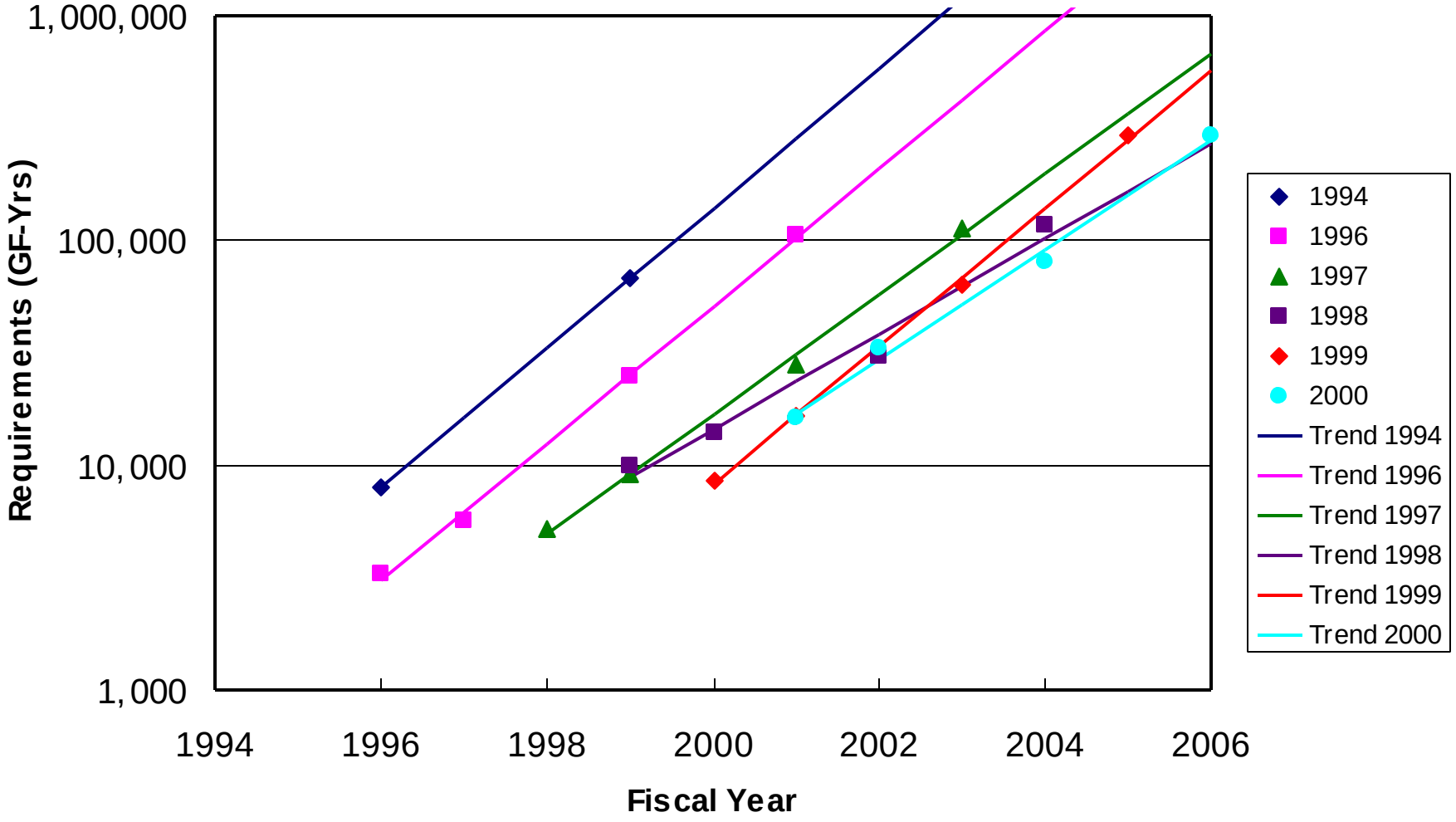
Need Your Support for the HPC POM 02 Issue

Requirements Update

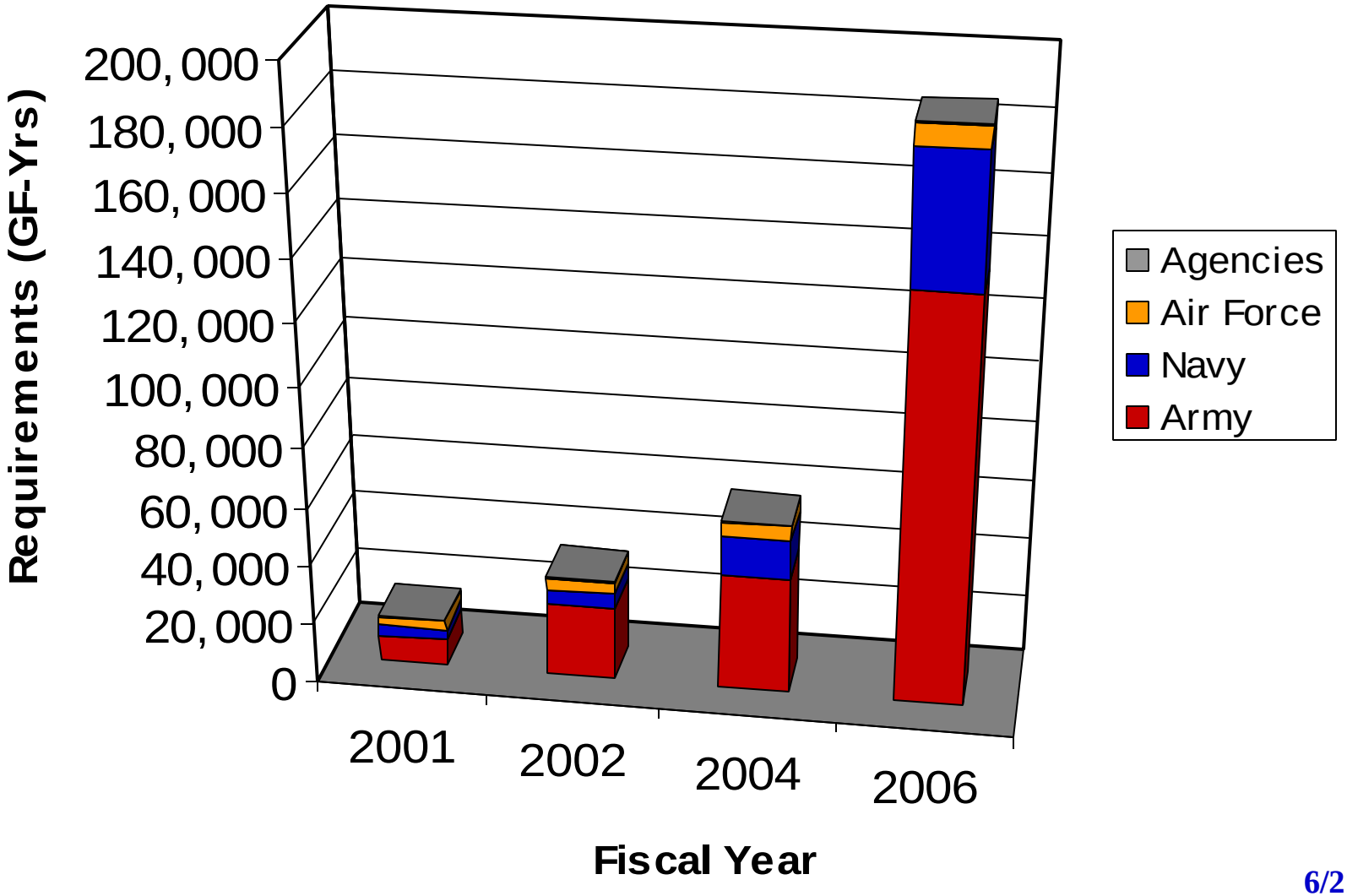
FY 2000 HPC Requirements Update: General Trends

- Substantial FY 2001 requirements; Future requirements continue to be considerably greater than expected capability
- Robust growth rate (growth factor of 1.8–2.0 per year)throughout five years of survey (FY 2001–FY 2006)
- Classified non-real-time requirements continue to be 10–15% of total non-real-time requirements
- Dominance of overall requirements by large projects (the "Breaux Hypothesis")
  - 50% of FY 2001 non-real-time unclassified requirements are due to the 6 largest projects
- Coalescence of requirements data over the last several surveys
  - Earlier trend of a given year's total requirements decreasing as time passes has largely disappeared

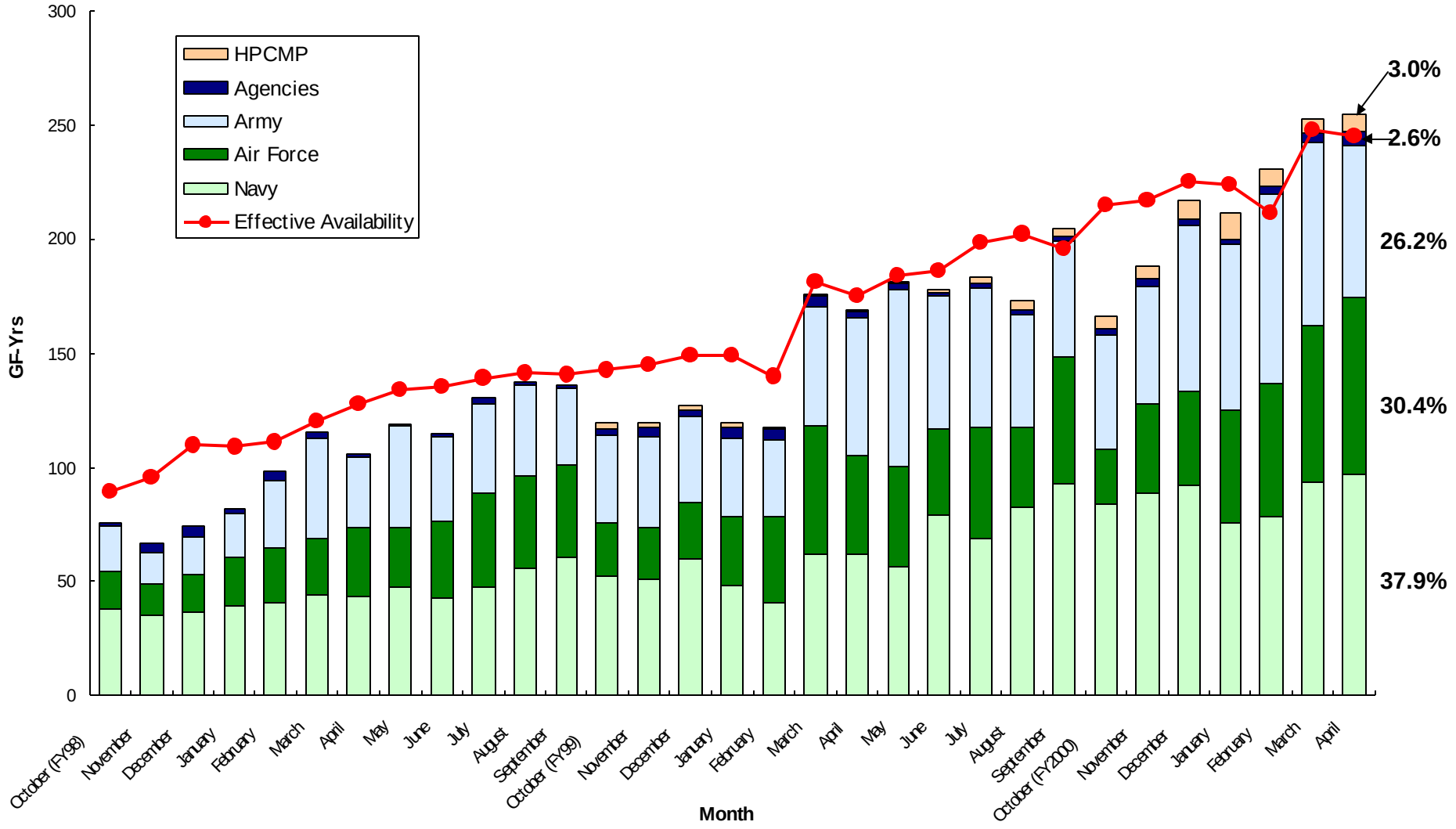
DoD Non-Real-Time HPC Requirements



DoD Non-Real-Time HPC Requirements By Service

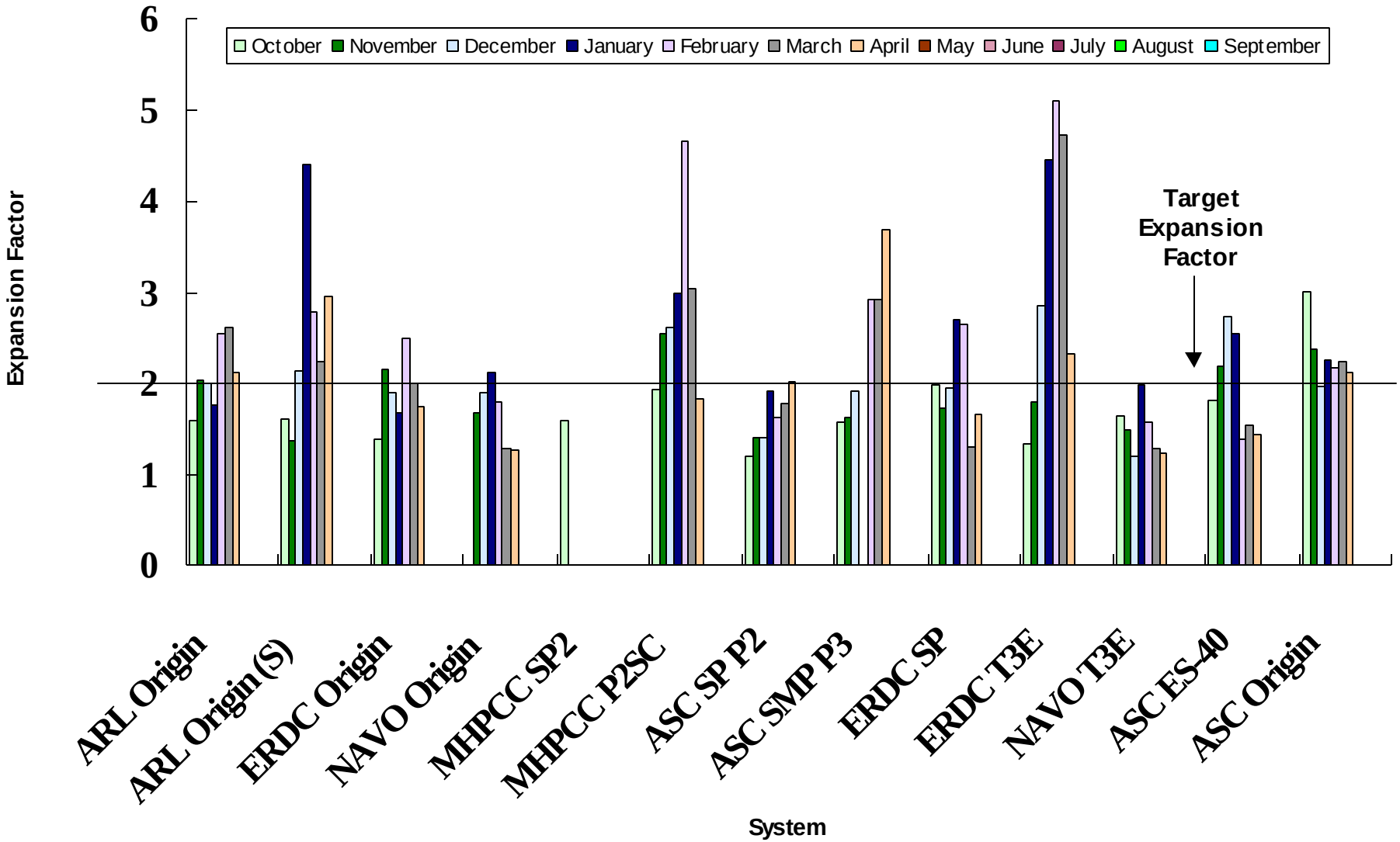


Total DoD Monthly CPU Usage Vs. Available Resources

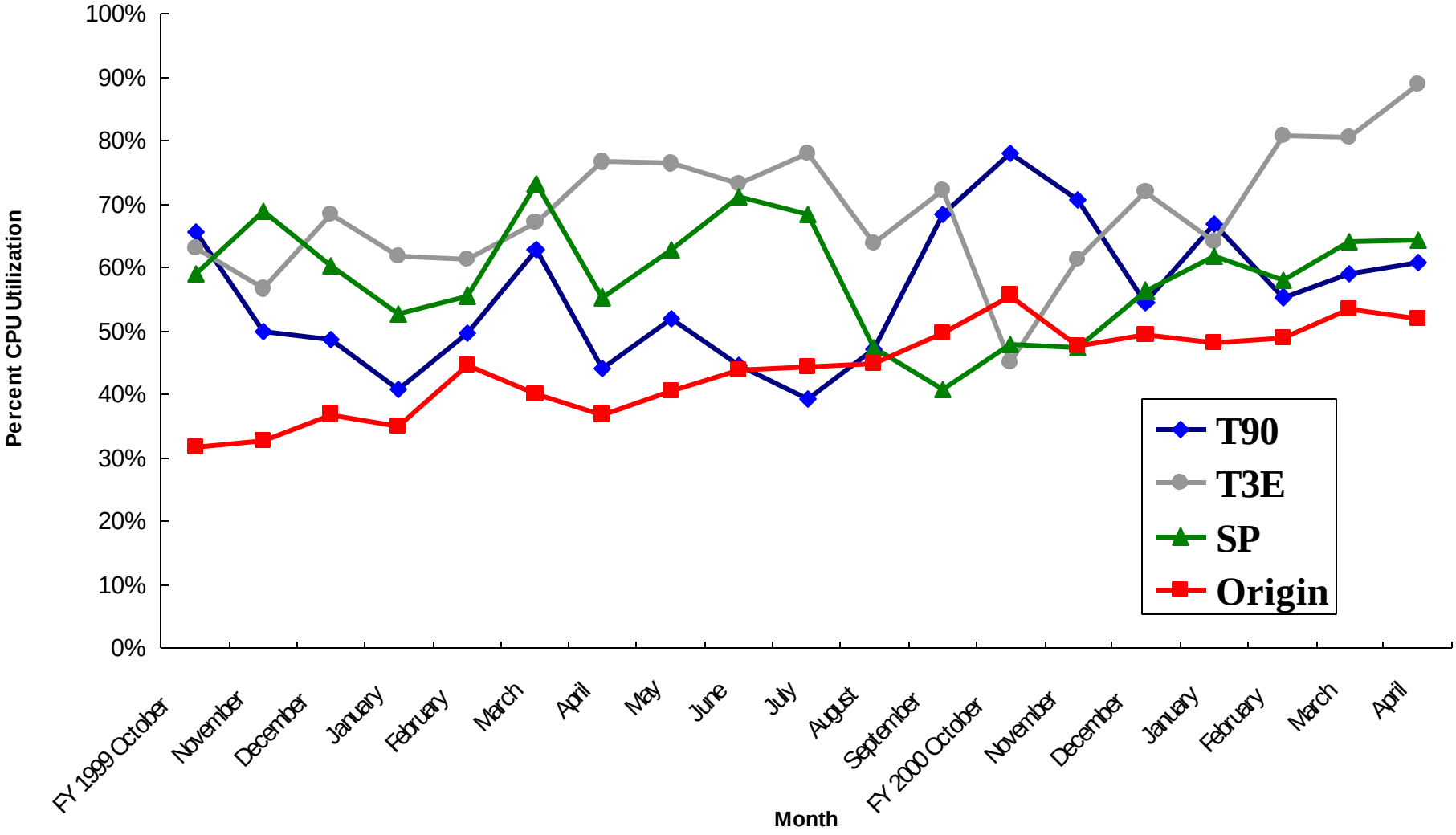


6/21/00

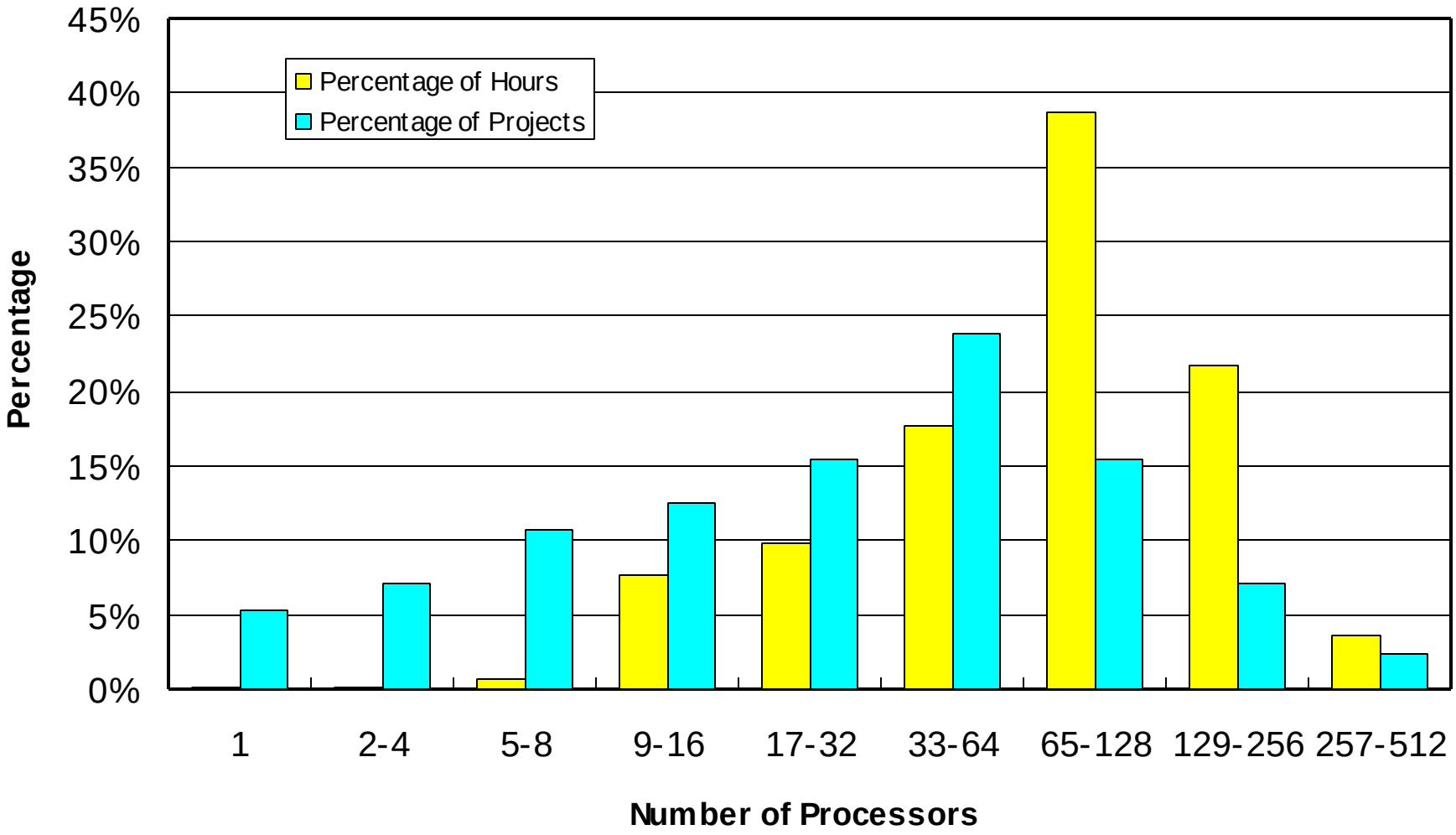
Normalized Scalable System Expansion Factors for FY 2000 Through April



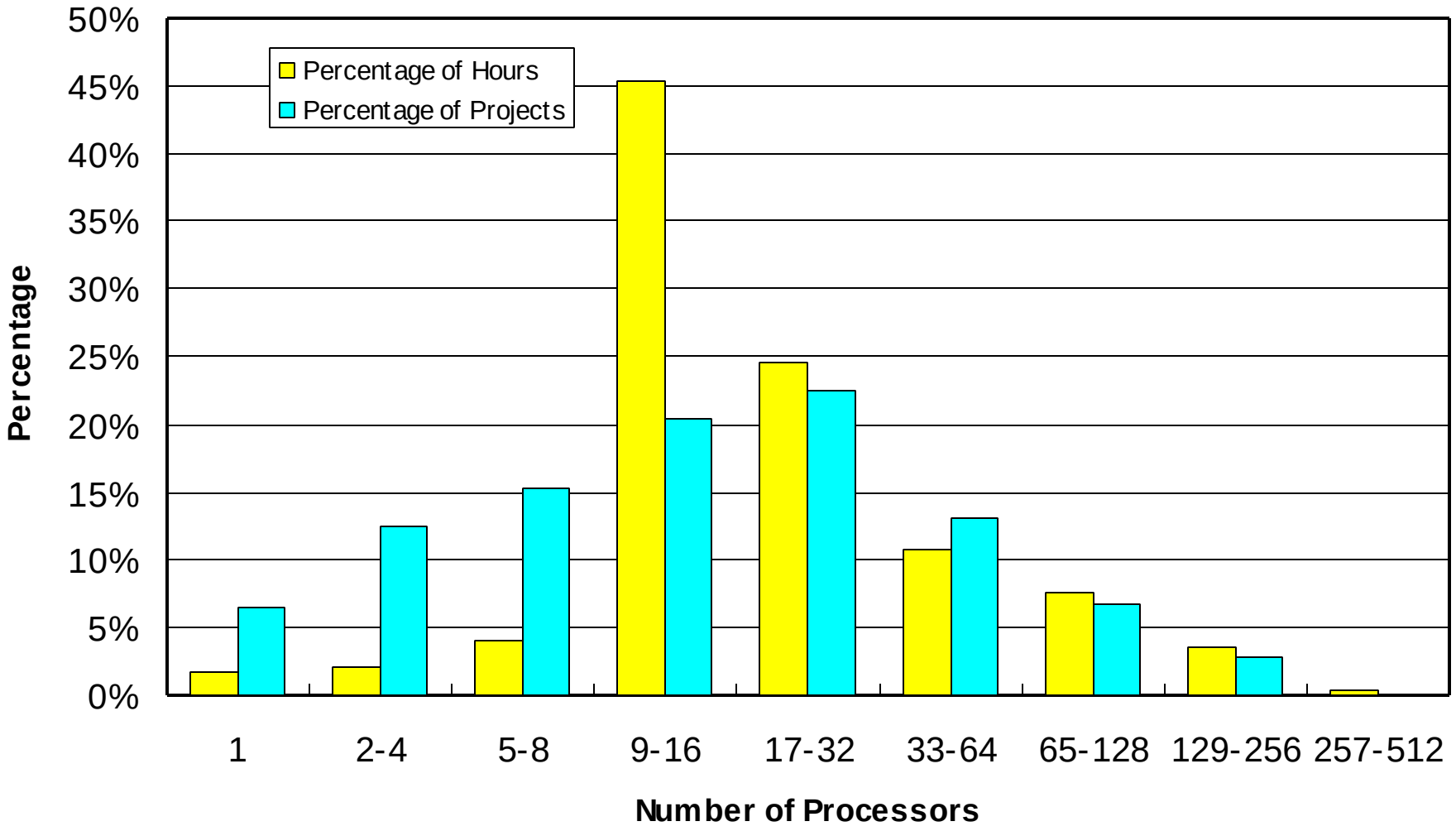
Monthly CPU Utilization Percentage by System Type Through March



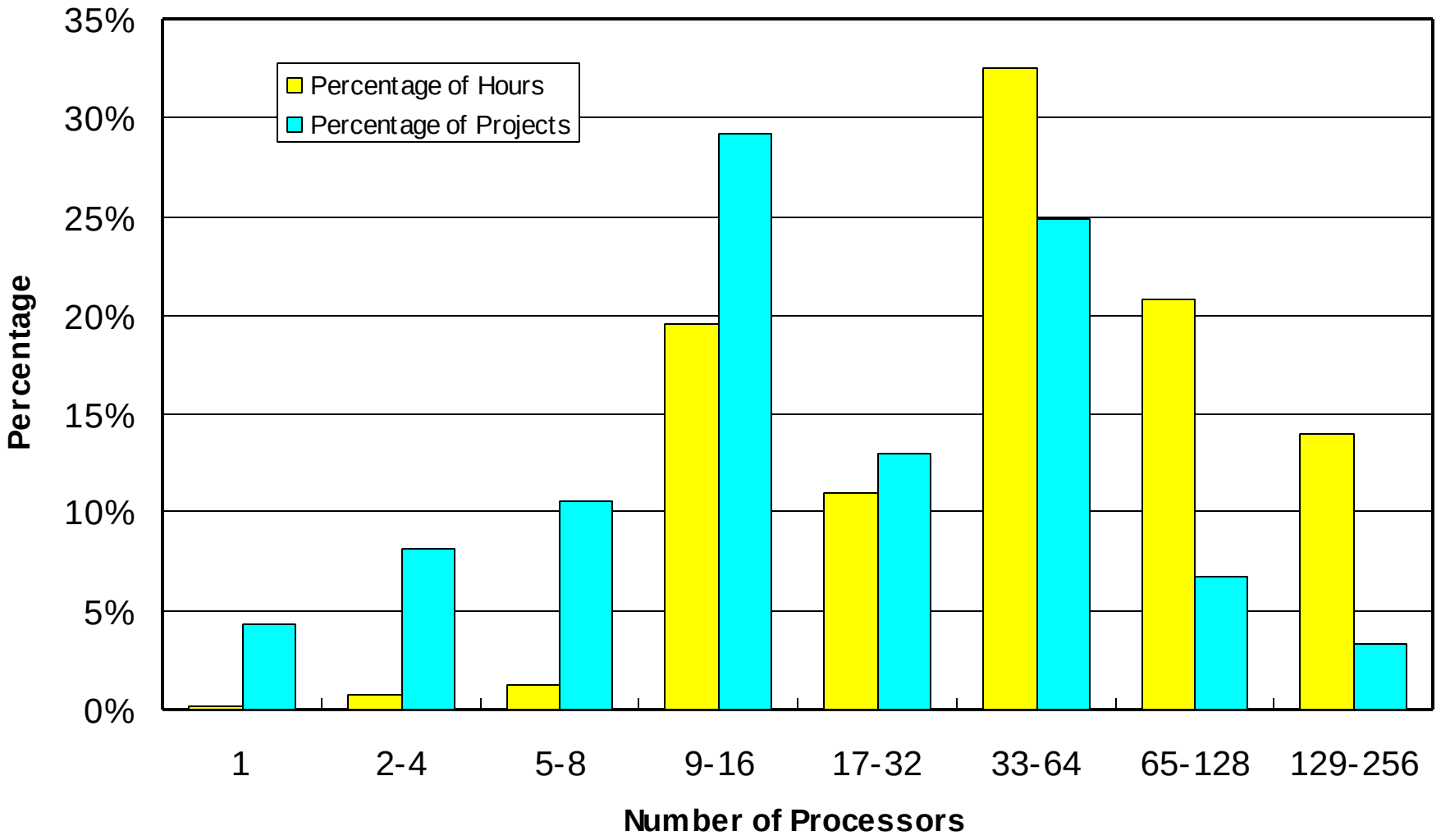
Cray T3E Processor Requirements



SGI Origin Processor Requirements



IBM SP/SMP Processor Requirements



Our Strategy for HPC Acquisitions

- Past:
  - Individual MSRC recommendations and HPCMO approval
  - Focus on local resource optimization based upon perceived local user needs
- Future:
  - New HPC acquisition strategy will focus on:
    - More explicit use of user requirements information
    - Decisions will be made on a program-wide basis
    - Support centers will be included in the overall decision
    - Extensive DoD benchmark results will be a major factor in decisions

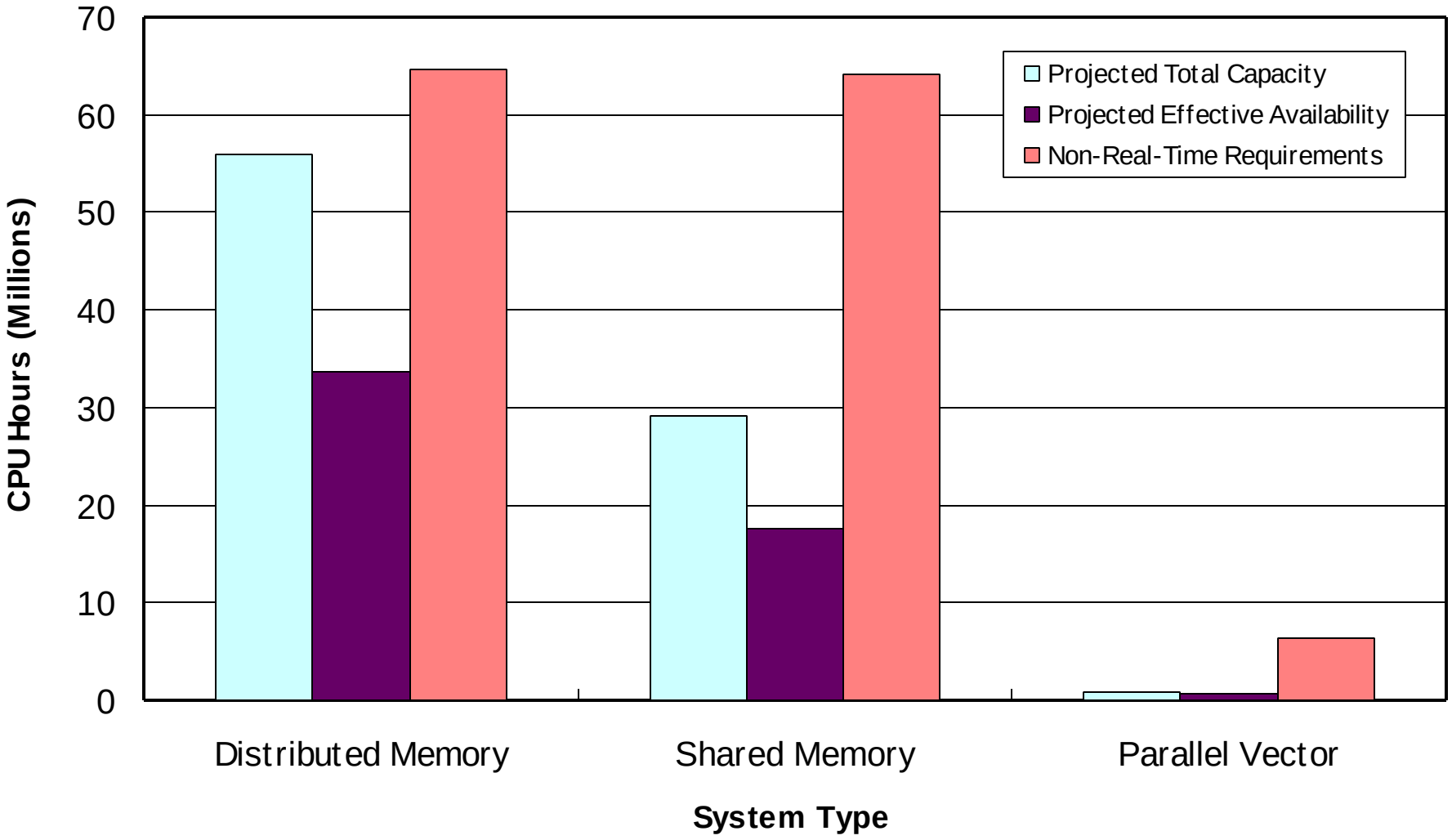
Application of User Requirements Data in HPC Acquisition Decisions

- Key decision factors:
  - HPC user requirements:
    - Gathered for each project as numbers of CPU hours on specific HPC systems
    - *Identify what you really need! (Use project description section if necessary)*
    - User bias:
      - » Users in general will request increasing amounts of time on known HPC systems for the upcoming several years
  - New technology opportunities that users may not be aware of
  - Software development and operating environments (tools, O/S, compilers)
  - Cost
  - Other factors, such as reliability, risk and ease of use
- Strategy:
  - Use both technology "push" and requirements "pull"
  - Determine key features of HPC capabilities that are required
  - Group specific system requirements by class of system

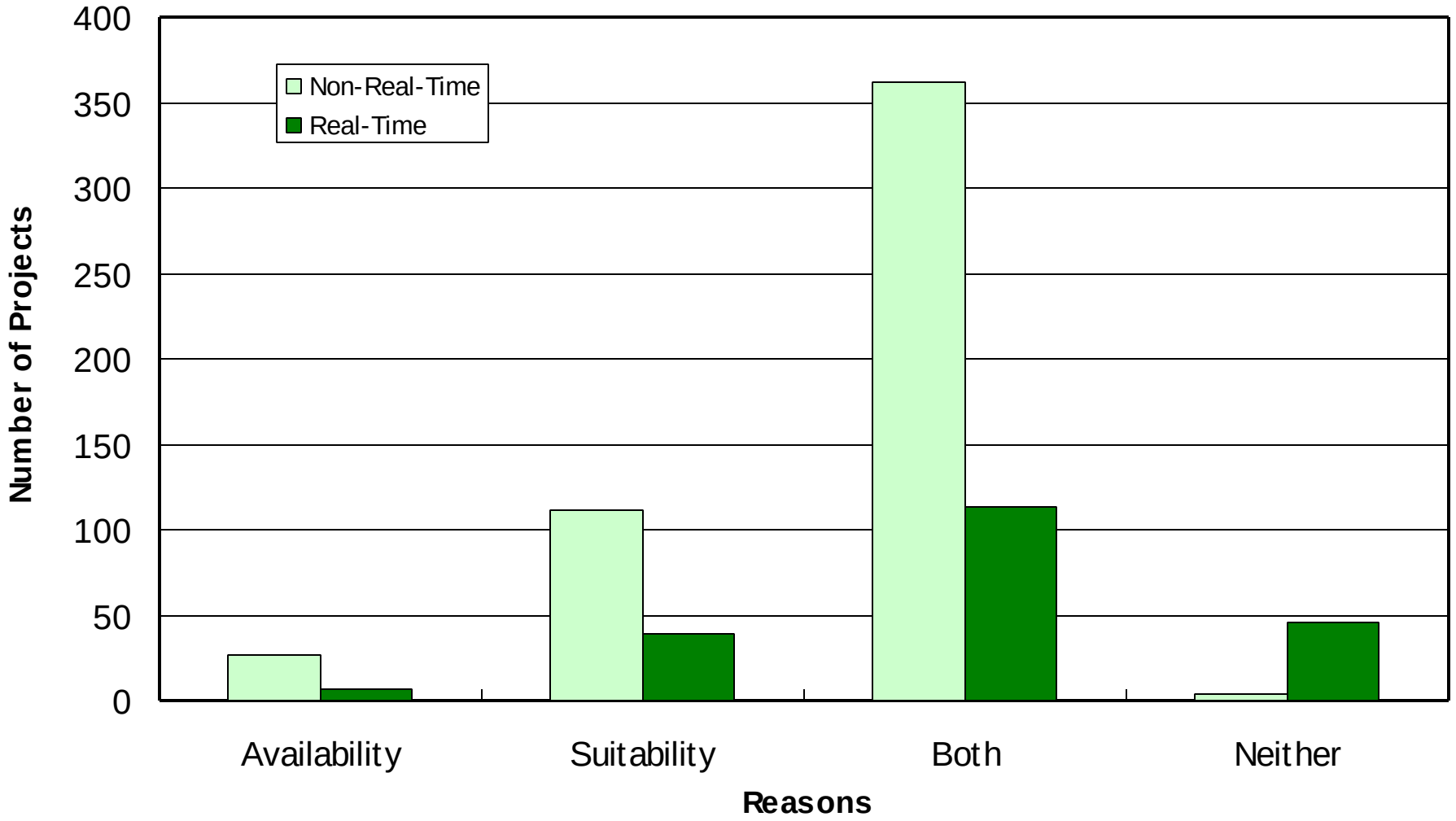
Non-Real-Time HPC Requirements by Class of System

- Three primary classes — distributed memory, shared memory, and parallel vector
- Distributed memory systems
  - IBM SP P2s and SP P3s
  - Cray T3Es
  - Compaq ES-40
- Shared memory systems
  - SGI Origins and SN1s
  - Sun E10000s
  - Compaq GS320
- Parallel vector systems
  - Cray T90s, J90s, SV1s
- New clustered SMPs can be used either as distributed or shared memory systems, or both simultaneously

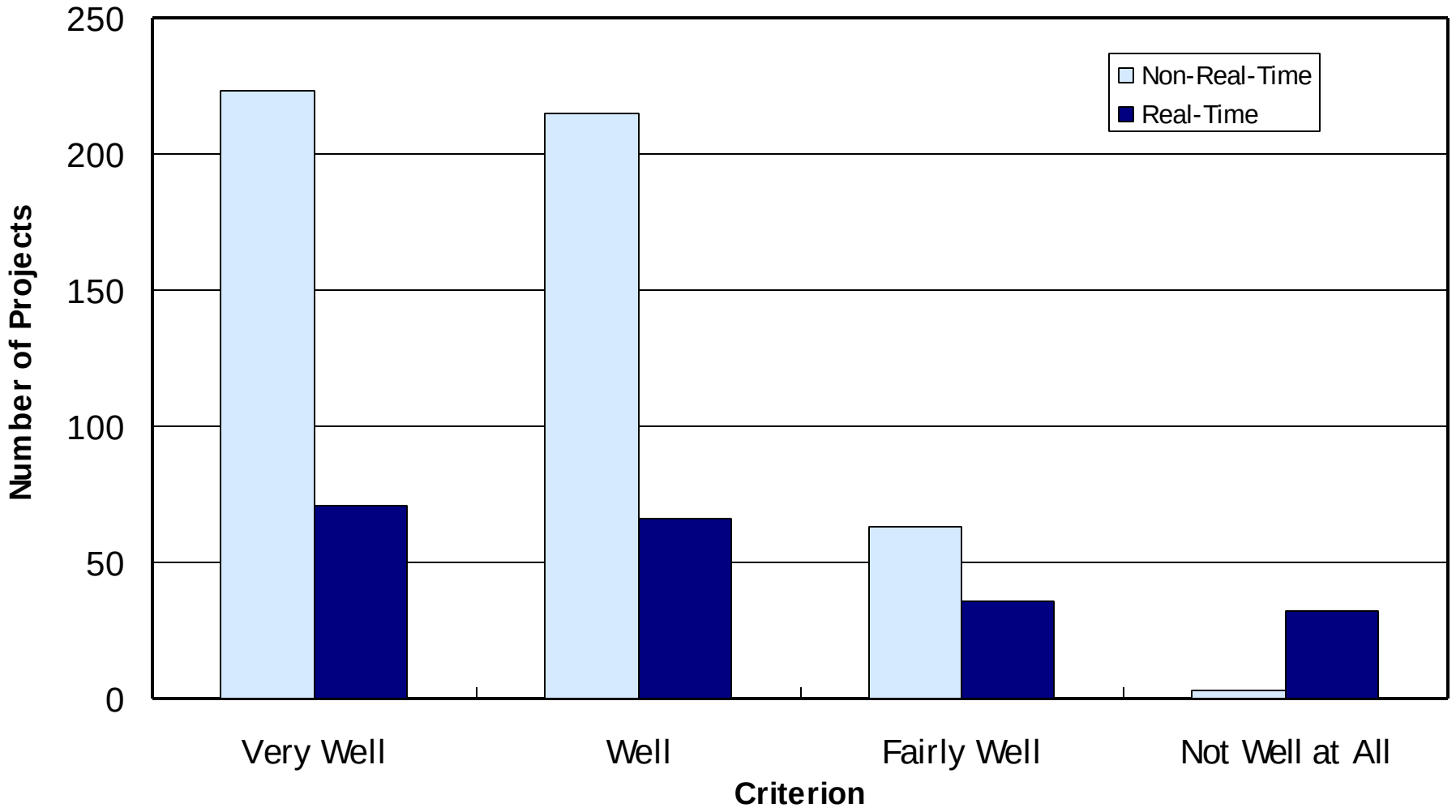
DoD FY 2001 HPC Requirements vs. Availability



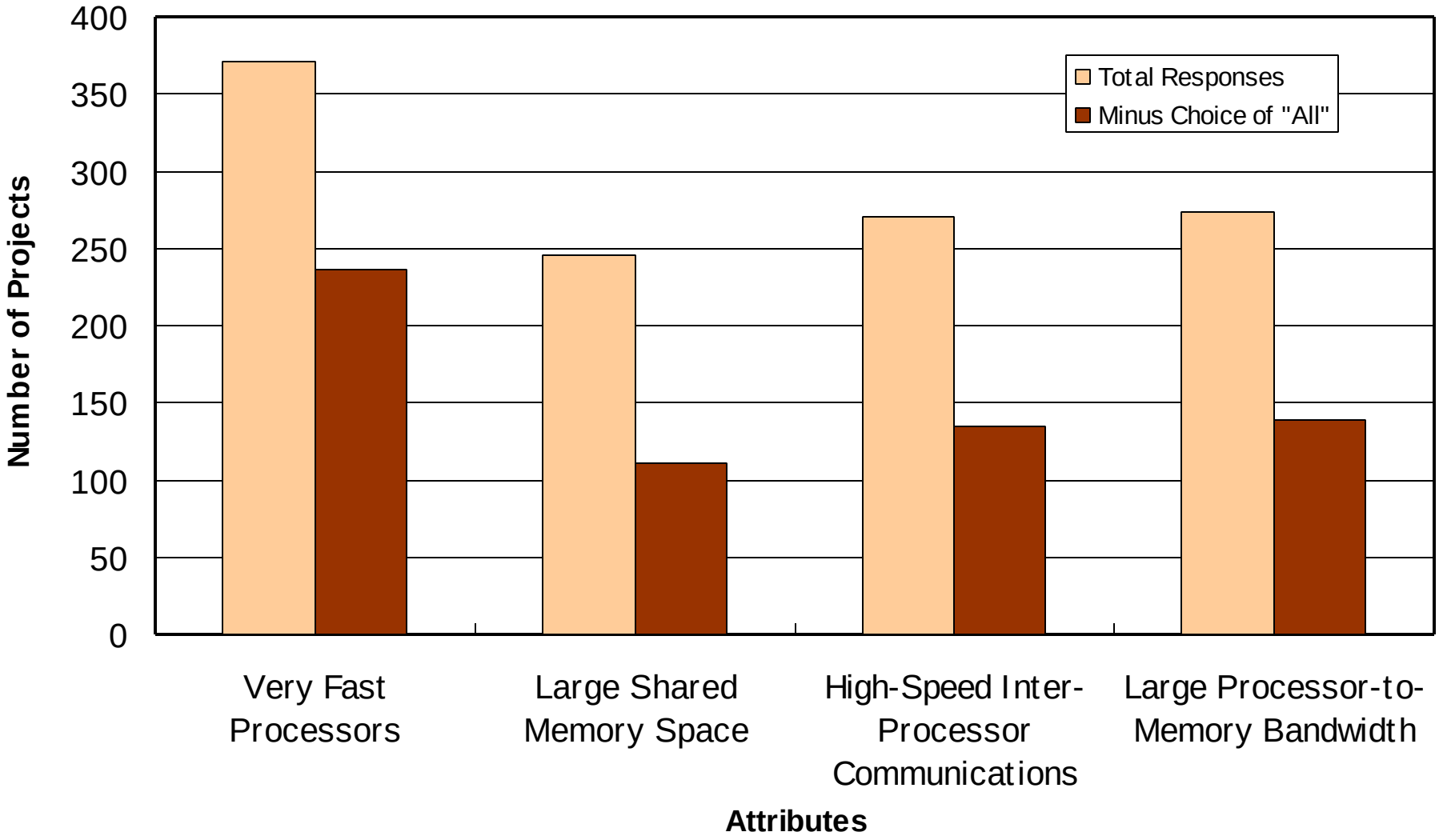
Why Did You Request the HPC Systems You Requested?



How Efficiently Do HPC Systems That You Are Requesting Run Your Application?



Which HPC System Attributes Are Required by Your Applications?



FY 2001 Resource Allocations

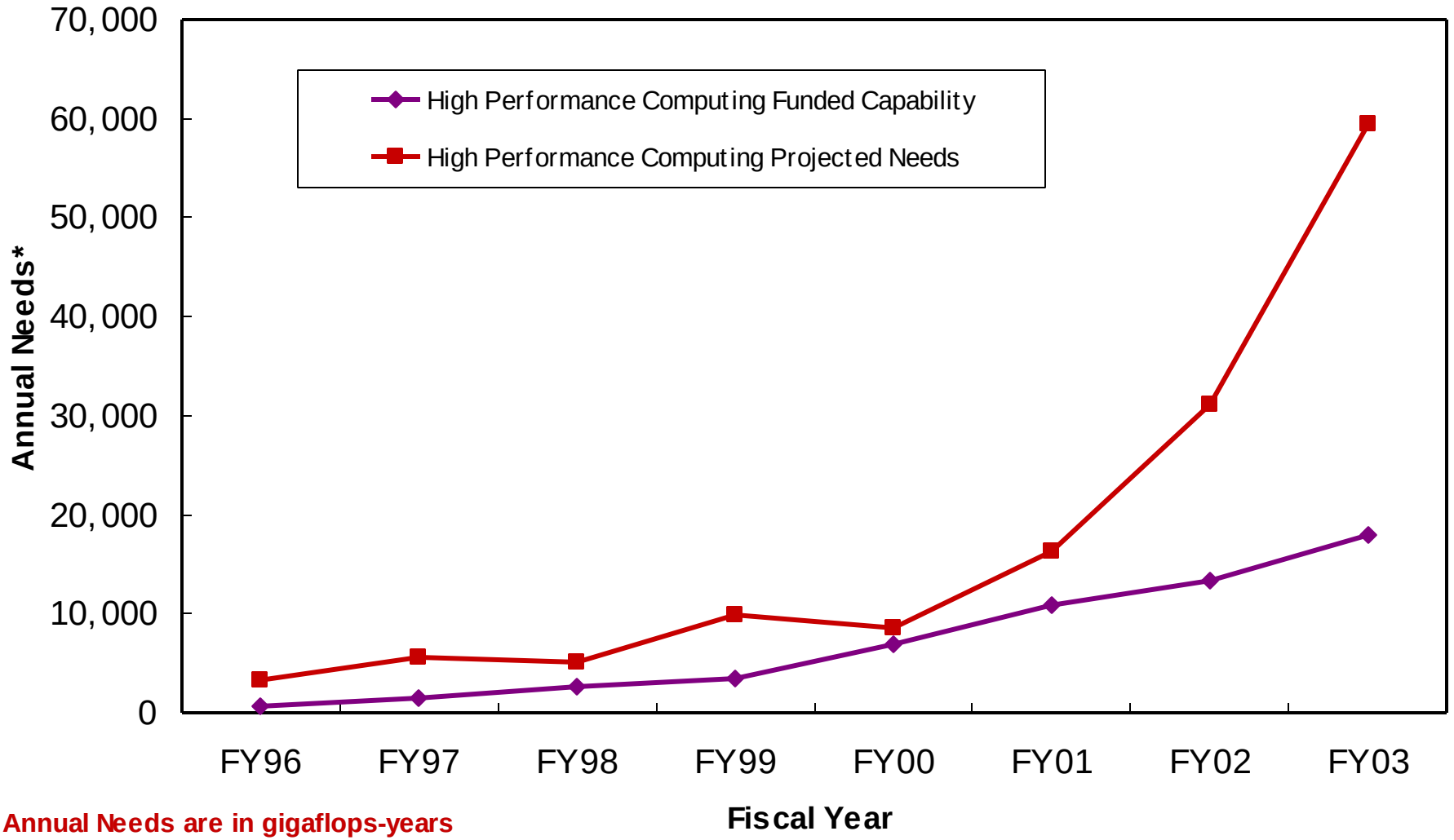
- All HPC systems at MSRCs will be allocated
  - Includes, for the first time, Secret-level classified systems
- Challenge Project proposal evaluations in progress
  - Announcement of selections and allocations expected in late June
- Service/Agency allocation requests to be sent in late June
  - Nominal allocation fraction (30/30/30/10) will be provided to a Service/Agency only if they have sufficient validated requirements for a particular system
- Five priority classes of computational work on allocated systems
  - Urgent (U) - unforeseen time-critical jobs
  - Challenge Projects (C)
  - High-Priority Service/Agency (H) - time-critical jobs known in advance
  - Standard Service/Agency (S)
  - Background (B)

Service/Agency Approval Authorities (S/AAAs)

- Are extremely important and necessary links between HPCMP and users
- Ensure Project Leaders and authorized users are performing work in support of DoD
- Implement requirements surveys, resource allocation, resource monitoring, and resource reallocation
- Provide guidance to users on which HPC assets are appropriate for their projects

DoD HPC Modernization Program

Non-Real-Time HPC Capabilities and Projected Needs



* Annual Needs are in gigaflops-years

Future HPC Agenda

Systems Acquisitions

Acquisition strategy will focus on:

- **More explicit use of user requirements information**
- **Decisions will be made on a program-wide basis**
- **Support centers will be included in the overall decision**
- **Extensive DoD benchmark results will be a major factor in decisions**

Networking Acquisition Status

- Current DISC expires July 2001
- June 1999 DISA agreed to extend the DISC contract for 2 years
- Acquisition Plan signed by the Milestone Decision Authority
- J&A completed by HPCMO and working through DITCO
- 2 March 2000 - DISA considering 3 year extension
- May 2000 - DISA agrees to full and open competition

Programming Environment and Training

- PET will continue!
- Several alternatives under consideration
- Timeline:
  - Ongoing strategic planning
  - End of summer -- Acquisition Plan
  - Oct-Nov 2000 -- Release of solicitation
  - Mar 2001 -- Award

HPCMP — Procurement Program

FY01 Fiscal Guidance

PE ($, 000)	Appropriation	FY00	FY01	FY02	FY03	FY04	FY05	FY06	FY07
FY 01 PBR									
0902198D8Z	PROC	95,865	39,978	50,445	49,348	50,333	51,892	52,930	53,988
-- MSRC		61,331	39,978	39,724	39,678	39,646	39,618	40,411	41,218
-- DC		34,534	0	10,721	9,670	10,687	12,274	12,519	12,770

- **Insufficient investment in current generation supercomputer systems**
- **Reduced funding starting in FY01 will only allow the program to meet a constantly declining percentage of requirements**

POM-02

PE ($, 000)	Appropriation	FY00	FY01	FY02	FY03	FY04	FY05	FY06	FY07
POM-02									
0902198D8Z	PROC	95,865	39,978	66,445	67,774	69,129	70,512	71,922	73,362
-- MSRC		61,331	39,978	51,445	52,474	53,523	54,594	55,686	56,801
-- DC		34,534	0	15,000	15,300	15,606	15,918	16,236	16,561

- **Allows for a refresh of supercomputer technology at the DCs every 3 to 4 years to support 14 Real-Time DCs**
- **Allows for a refresh of supercomputer technology at the MSRCs every 4 years**

DELTA	02	03	04	05	06	07
Procurement	(16,000)	(18,426)	(18,796)	(18,620)	(18,992)	(19,374)

HPCMP — RDT&E Program

FY01 Fiscal Guidance

PE ($, 000)	Appropriation	FY00	FY01	FY02	FY03	FY04	FY05	FY06	FY07
FY 01 PBR									
0603755D8Z	RDT&E	164,264	164,027	137,988	143,038	145,808	148,643	151,616	154,648
-- CHSSI		21,569	22,304	20,681	20,662	21,782	22,253	22,698	23,152
-- DREN		29,295	32,691	32,884	33,090	33,665	34,617	35,309	36,016
Sustainment -- MSRC/DCs		113,400	109,032	84,423	89,286	90,361	91,773	93,609	95,480

- **Does not include sufficient resources to implement critical security upgrades and appropriate software support efforts**
- **No sustainment support at the congressional interest DCs beyond FY01**

POM-02

PE ($, 000)	Appropriation	FY00	FY01	FY02	FY03	FY04	FY05	FY06	FY07
POM-02									
0603755D8Z	RDT&E	164,264	164,027	158,142	161,305	164,531	167,821	170,776	174,258
-- CHSSI		21,569	22,304	23,681	24,155	24,638	25,130	25,633	26,146
-- DREN		29,295	32,691	35,884	36,602	37,334	38,080	38,440	39,276
Sustainment -- MSRC/DCs		113,400	109,032	98,577	100,548	102,559	104,611	106,703	108,836

- **Includes critical security upgrades**
- **Sustainment support is provided to the congressional interest DCs**

DELTA	02	03	04	05	06	07
RDT&E	(20,154)	(18,267)	(18,723)	(19,178)	(19,579)	(19,987)

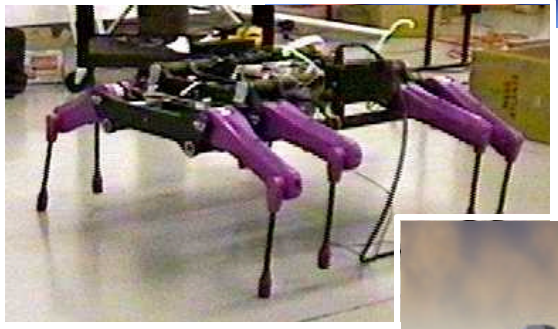
6/21/00

Future Revolutionary Capabilities

HPC is Essential to Future Technology Development

Microsatellites

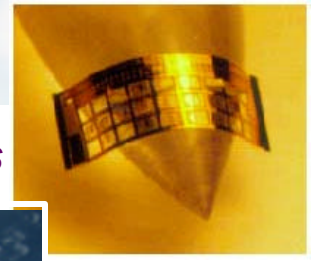
Micro Air Vehicles



Micro Robots

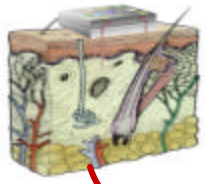
DD-21

Joint Strike Fighter



Flexible Sensor Skins

Augmented Reality



Bio Sensors

Embedded Biofluidic Chips

6/21/00